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Pfister et al.

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(54) **COMBUSTION POWER-OPERATED SETTING TOOL**

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(51) **Int. Cl.**
B25C 1/14 (2006.01)

(52) **U.S. Cl.** **227/9**; 227/10; 89/1.14

(58) **Field of Classification Search** ..... 227/9, 227/10, 11, 130; 123/46 SC; 89/1.14
See application file for complete search history.

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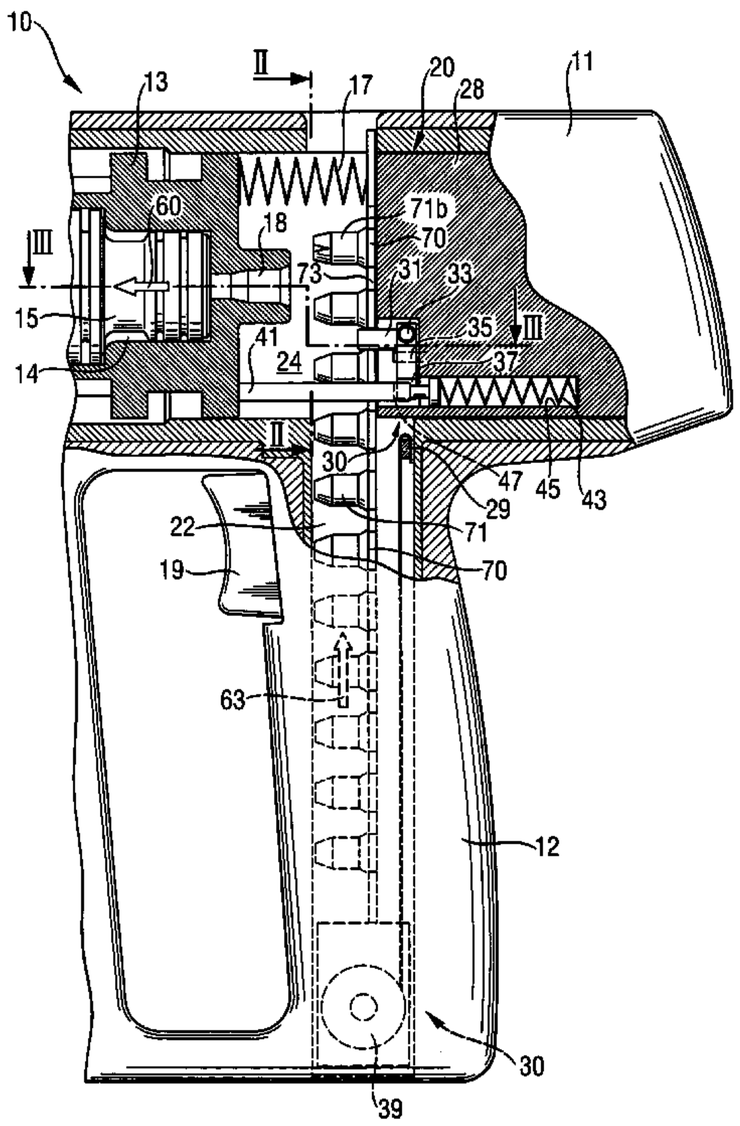
(57) **ABSTRACT**

An explosive powder charge-operated setting tool for driving fastening elements in a constructional component includes a propellant-driven setting mechanism, an ignition element (**23**) for igniting a propellant (**71**) received in the propellant receptacle (**18**) of the setting mechanism, and a transporting device (**30**) for displacing a propellant magazine in a guide channel (**22**) and including elements operable by the ignition element (**23**) for displacing the transporting device from a first position in which the transportation of propellants is prevented, into a second position in which at least partial transportation of the propellants is possible.

11 Claims, 9 Drawing Sheets



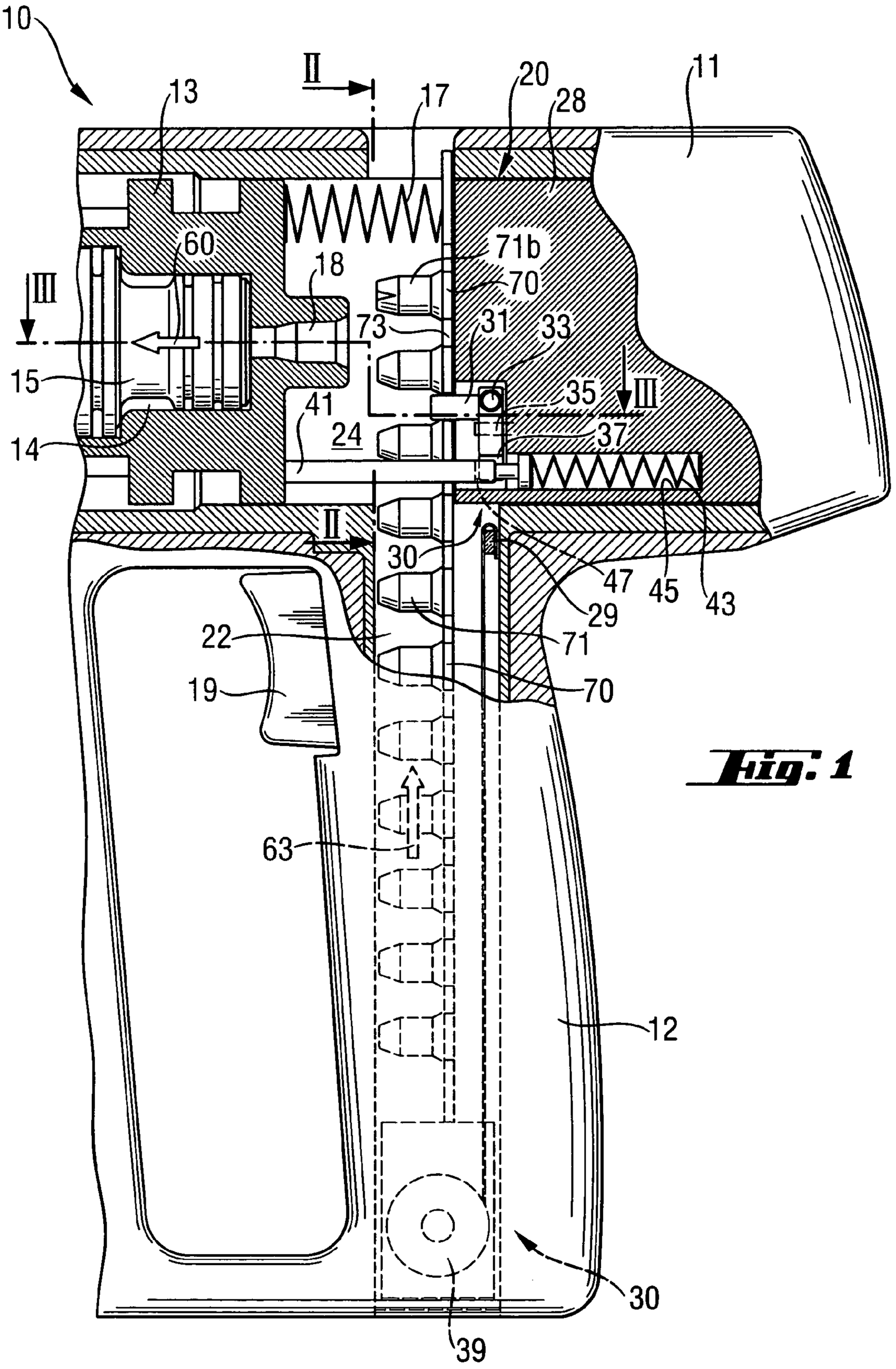

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Fig. 1

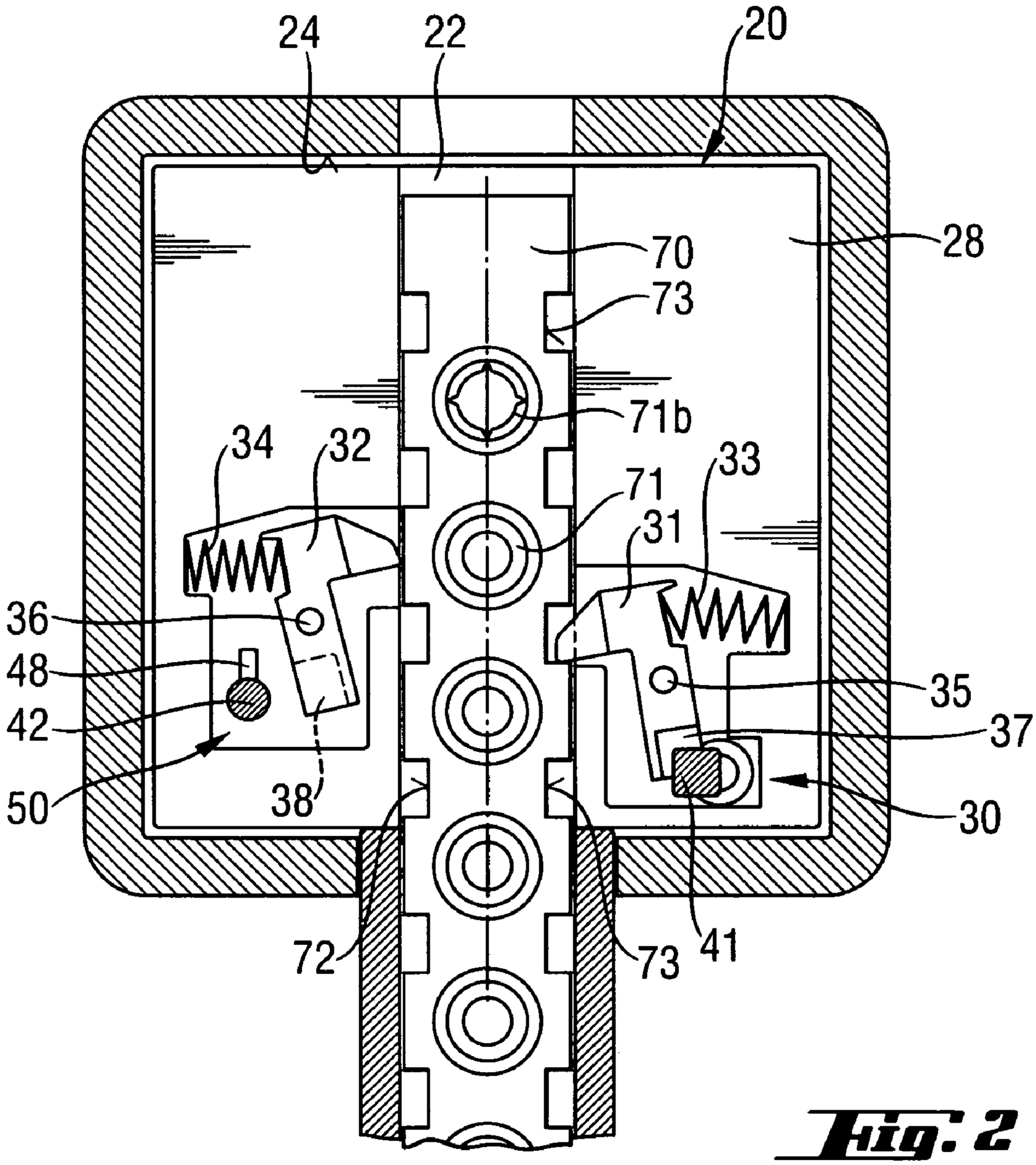

Fig. 2

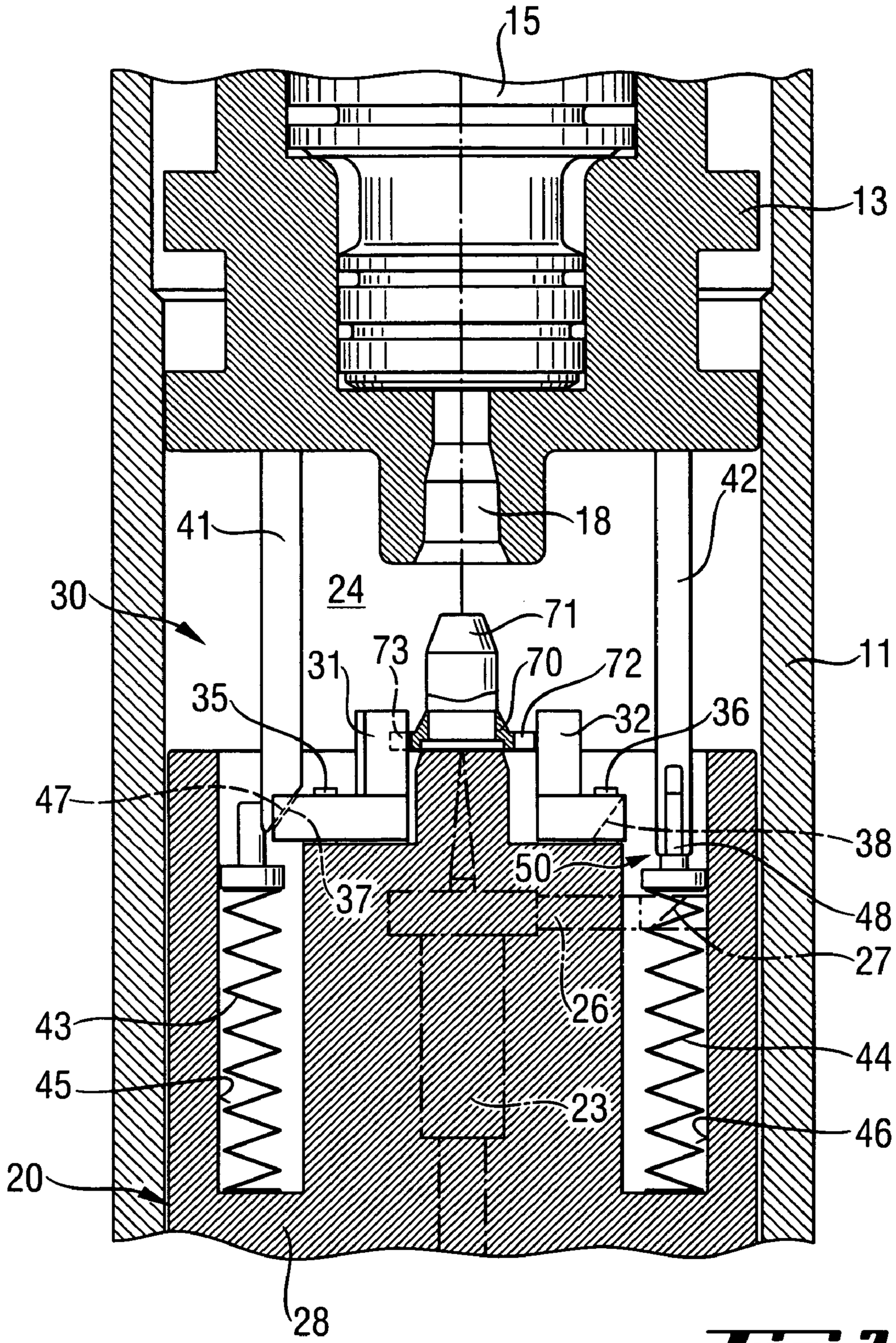
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Fig. 3

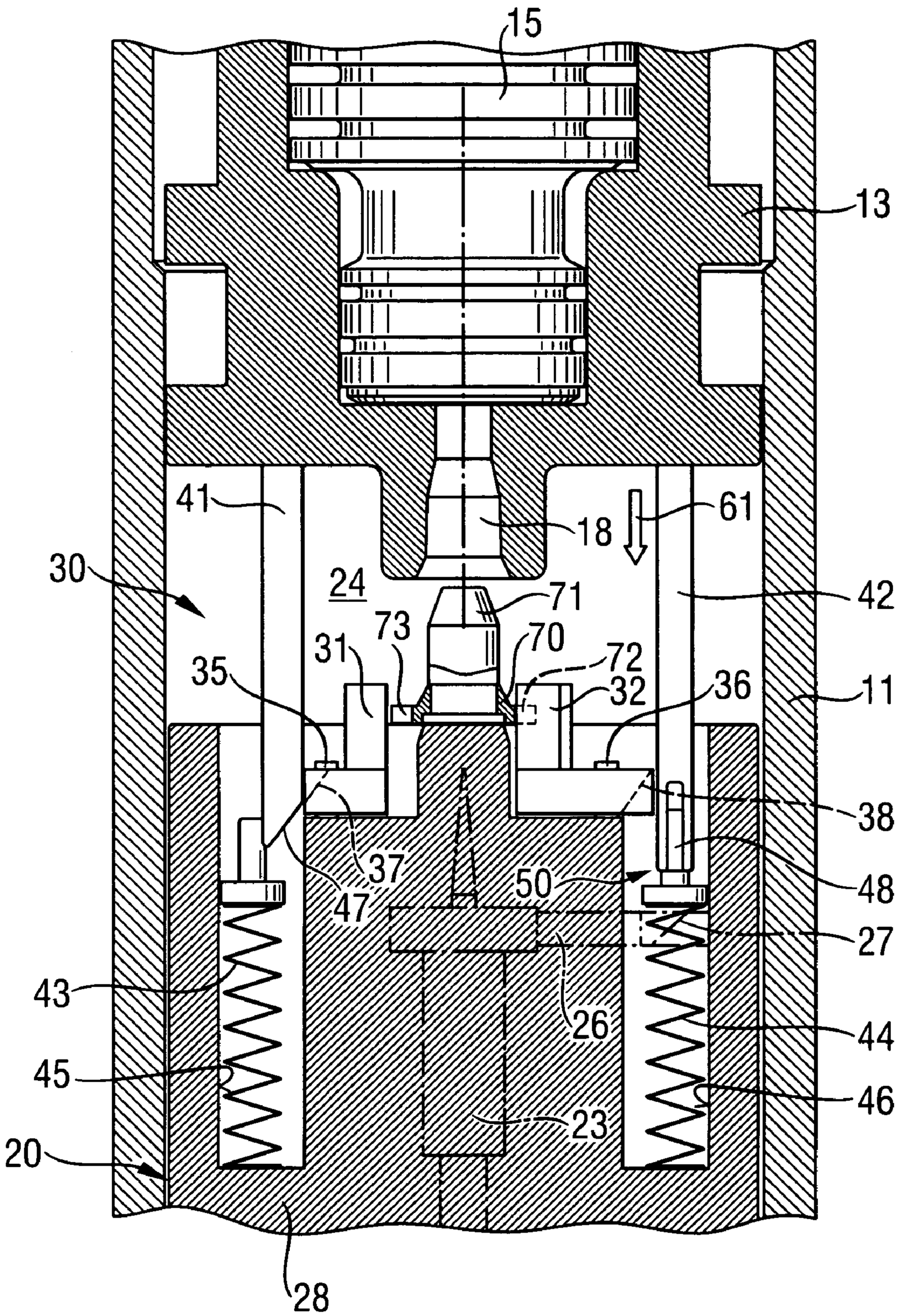
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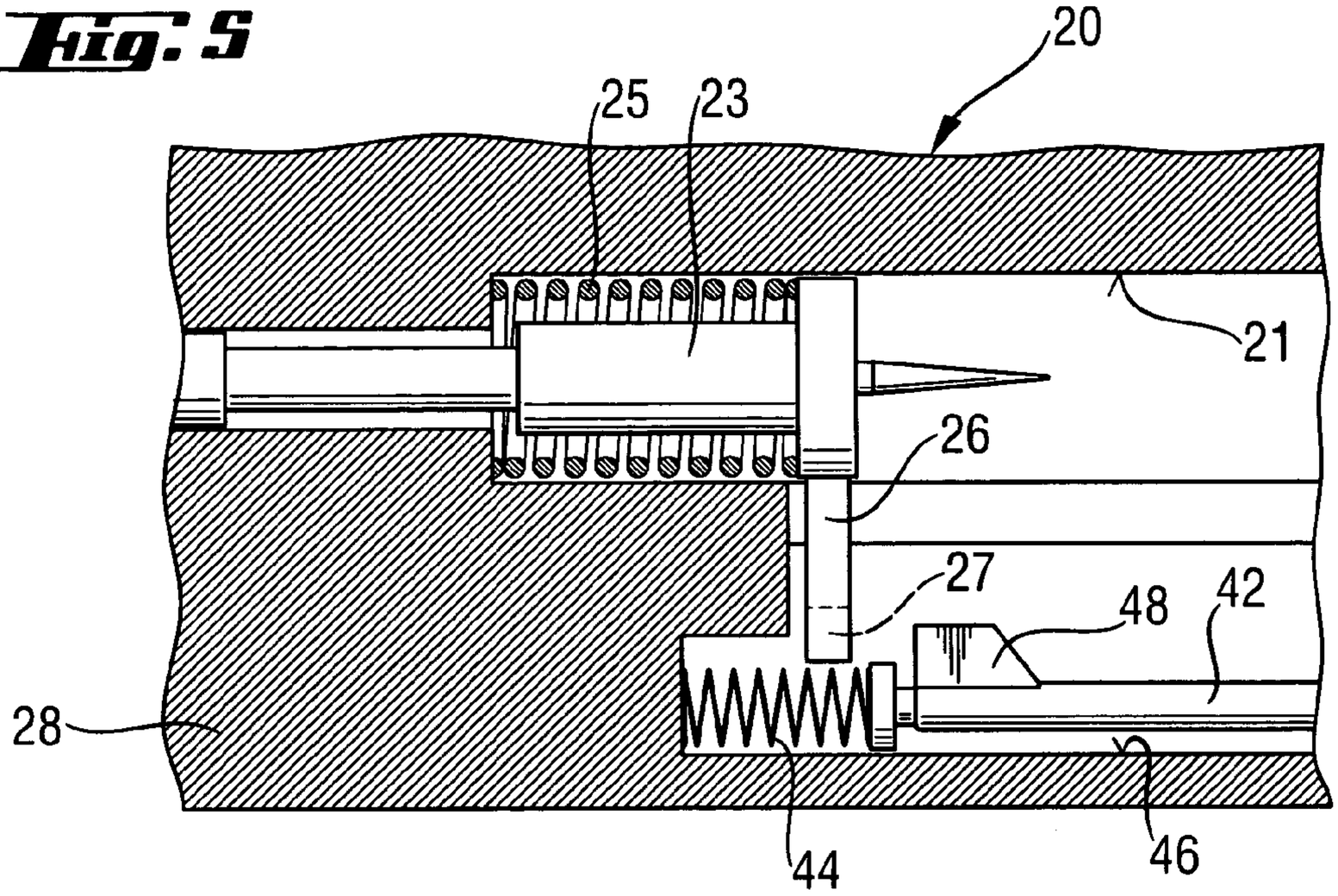
Fig. 4

Fig. 5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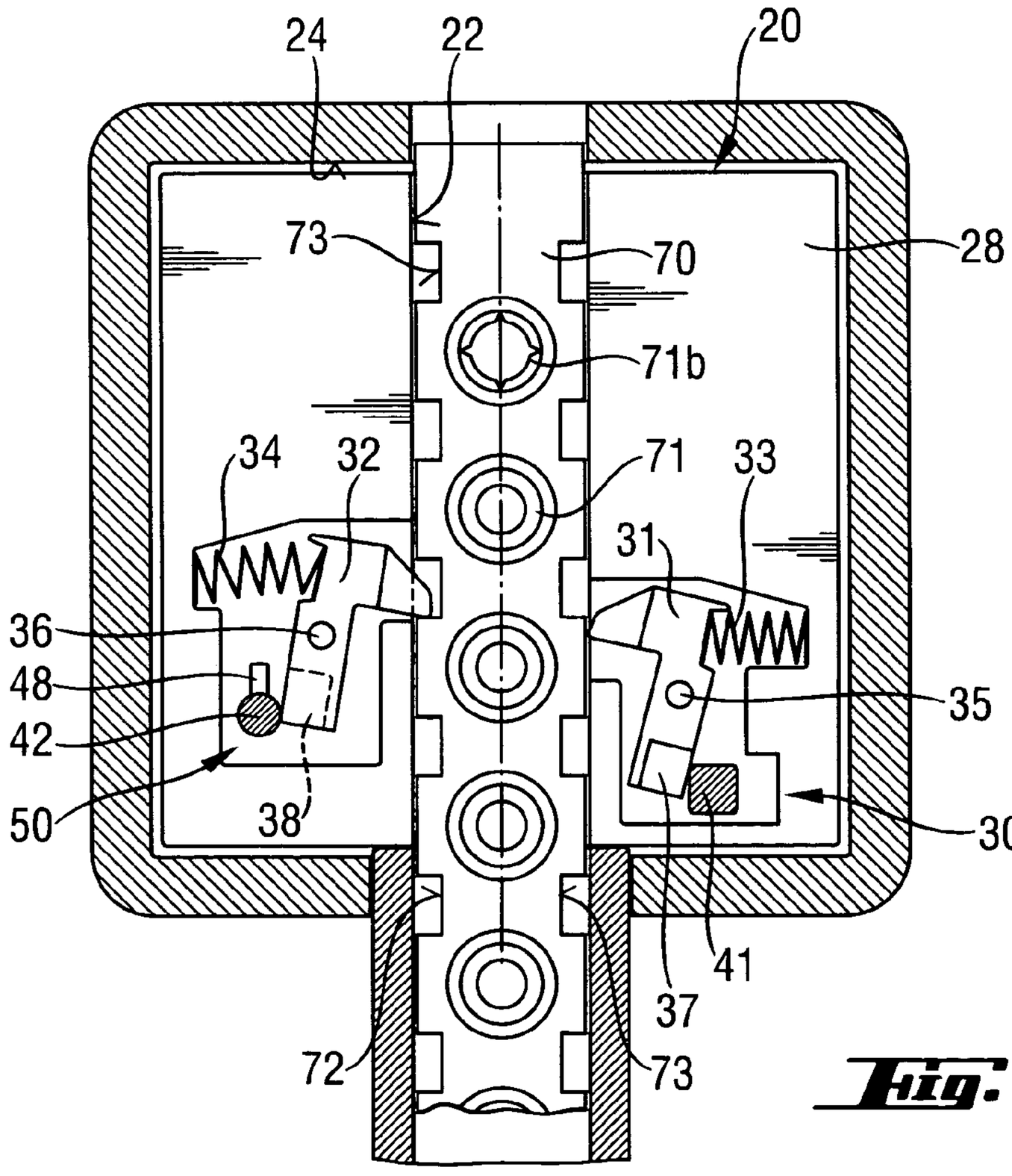
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Fig. 6

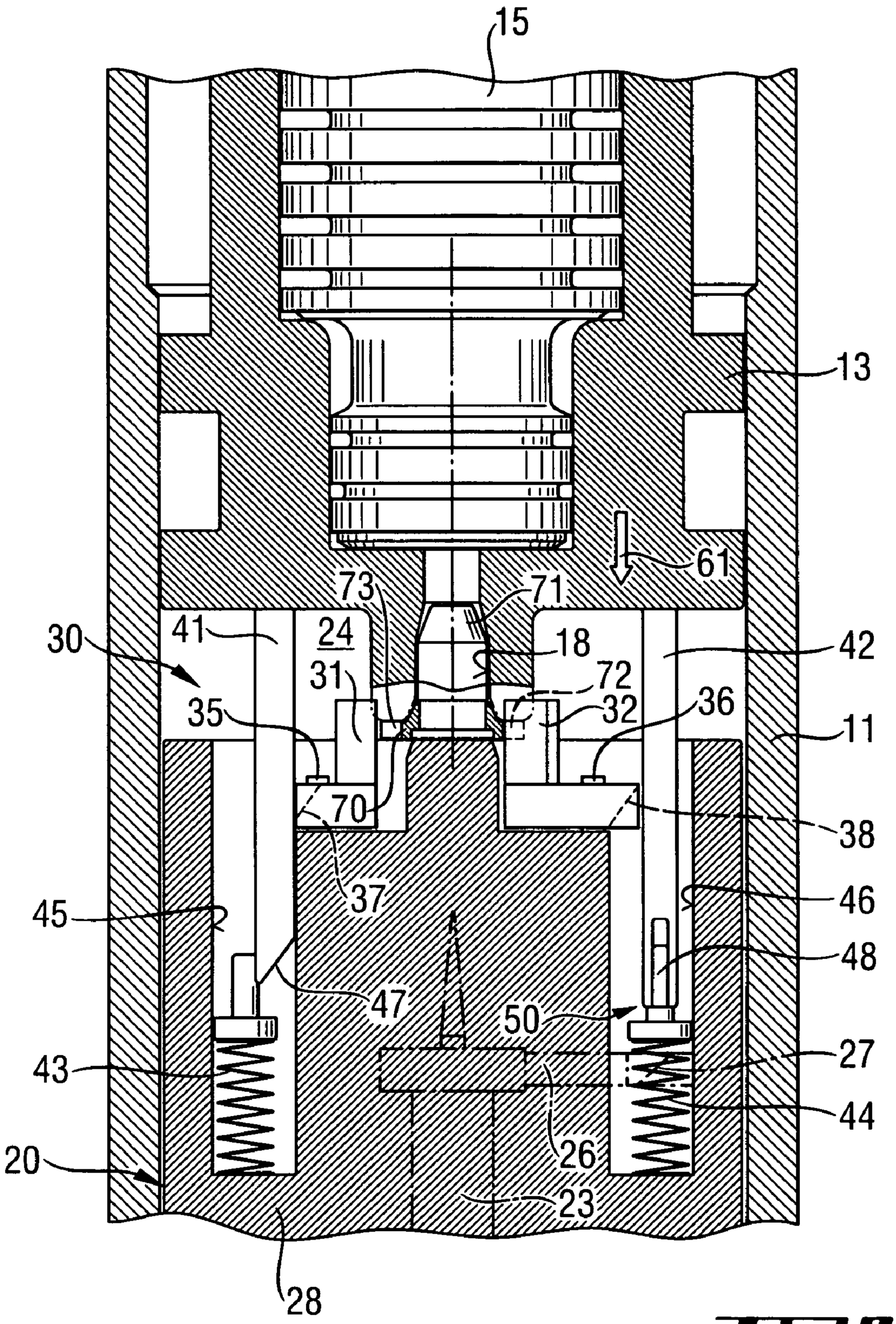
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Fig. 7

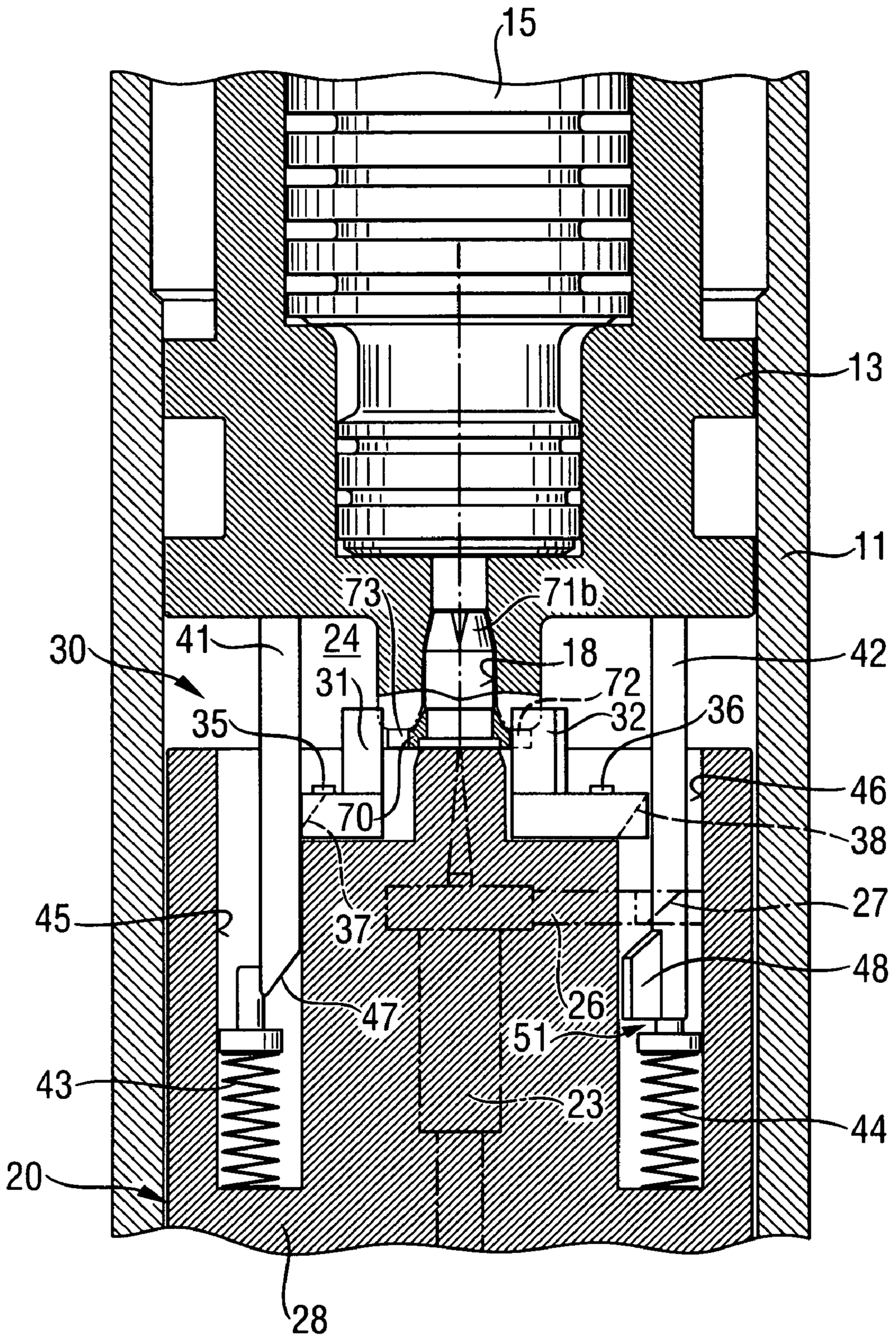
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Fig. 8

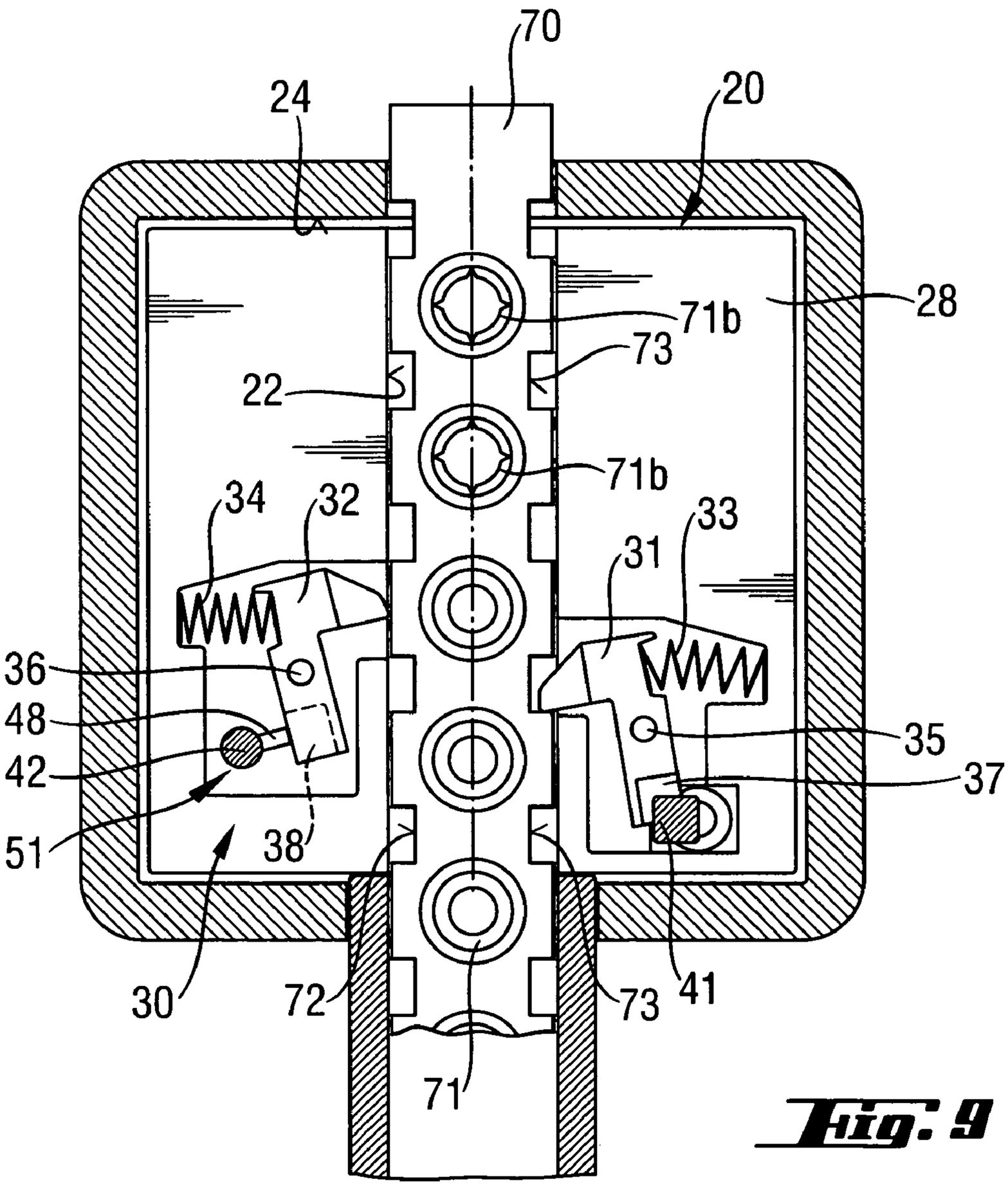
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Fig. 9

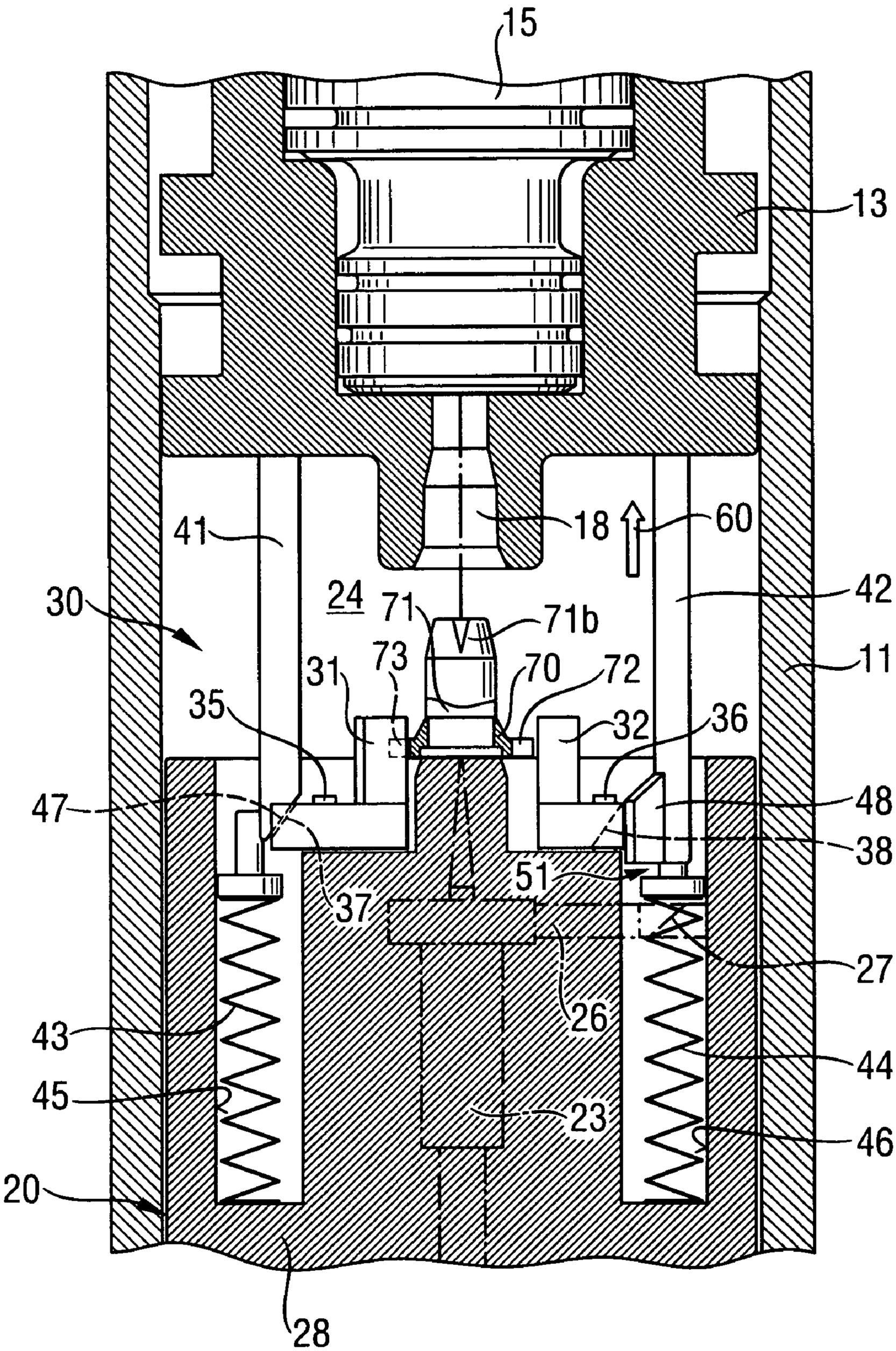
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Fig. 10

COMBUSTION POWER-OPERATED SETTING TOOL

BACKGROUND OF THE INVENTION

1. Field of Invention

The present invention relates to a combustion power-operated setting tool such as an explosive powder charge-operated setting tool for driving fastening elements in a constructional component and including a propellant-driven setting mechanism including a propellant receptacle for receiving a propellant, ignition means for igniting the propellant received in the propellant receptacle, a guide channel for receiving a propellant magazine, and a transporting device for displacing the propellant magazine in the guide channel.

2. Description of the Prior Art

The setting tools of a type described above operate, mostly, with solid fuels in form of cartridges filled with the explosive powder or in form of pellets made of compressed explosive powder. The setting mechanism of these setting tools includes a piston guide which is at least partially arranged in the tool housing, and a setting piston axially displaceable in the piston guide. The setting piston of these setting tools is driven by combustion gases of the fuel. The setting piston drives fastening elements, such as nails, bolts, etc. in the constructional components. After completion of a setting process, the setting piston should be returned to its initial position. The propellants are fed to the propellant receptacle in the setting tool, e.g., in form of a magazine strip. As a rule, after completion of a setting process, the magazine strip, which is displaced in a guide channel, is displaced by a transporting mechanism by one cartridge.

German Publication DE 30 359 28 A1 discloses a combustion power-operated setting tool in which the cartridges are displaced by a mechanism that is actuated upon the setting tool being pressed against a constructional component. The transportation of the cartridges, however, is blocked if the setting tool, upon having been pressed against a constructional component, is not actuated. The blocking can, however, be released upon actuation of overriding means, e.g., in order to unload the setting tool. The transporting mechanism includes a transporting slide that is arranged on the displaceable in the housing piston guide in the region of the cartridge socket. The transporting slide is connected by a lever with a transporting pawl that engages the magazine strip.

The drawback of the known setting tool consists in that the cartridge, which is located in the cartridge socket, is transported further even when the cartridge is not ignited after actuation of the setting tool. A new actuation attempt with the same cartridge is not possible.

Accordingly, an object of the present invention is to provide a setting tool in which the drawback of the known combustion power-operated setting tool is eliminated.

Another object of the present invention is to provide a setting tool in which a reliable transportation of cartridges during a setting process is insured.

SUMMARY OF THE INVENTION

These and other objects of the present invention, which will become apparent hereinafter, are achieved by providing a setting tool of the type described above and the transporting device of which includes means operable by the ignition means for displacing the transporting device from a first position in which the transportation of propellants is prevented, into a second position in which at least partial transportation of the propellants is possible. For operating the displacing means, an ignition displacement of the ignition means, e.g., of a firing pin is used when it is advanced toward a propellant located in the propellant receptacle. This insures that a non-consumed propellant can only then be completely transported up to the propellant receptacle or be at least partially transported toward the propellant receptacle when the ignition means actually strikes, after actuation of the setting tool, the propellant in the propellant receptacle. In case when the ignition means is not displaced, the transportation device is not released so that the same propellant would be enclosed in the propellant receptacle when the setting tool is pressed against a constructional component anew. A non-consumed propellant would not be automatically transported.

Advantageously, the transporting device includes transporting spring means for biasing the propellant magazine, e.g., a propellant strip or a cartridge strip, which is received in the guide channel, in a transporting direction. The spring means provides for a technically simple displacement of the propellant magazine.

It is further advantageous when the transporting device displacing means includes at least one locking member and a spring for biasing the at least one locking member in a direction toward the guide channel into a position in which transportation of the propellant is blocked. The locking member fixes the magazine or the propellant strip in its position in the guide channel until the locking member is actuated. Advantageously, the locking member cooperates with recesses provided on a side of the propellant strip. The side recesses permit to control in a simple manner the displacement of the propellant strip by the transporting spring means.

Advantageously, the transporting device includes at least one actuator for displacing the at least one locking member against a spring-biasing force of the biasing spring from the position in which the transportation of the propellants is blocked, into a position in which the transportation of the propellants becomes possible. Thus, the actuator controls the operation of the locking member.

Advantageously, the at least one actuator is displaced by the ignition means from a release position in which displacement of the at least one locking member by the actuator is prevented, into an actuation position in which the displacement of the at least one locking member by the actuator becomes possible. If a further actuator is provided, it can be controlled exclusively by the press-on mechanism of the setting tool. In this way, the transporting device can be controlled or at least partially controlled in a simple manner. It can further be advantageous to provide the ignition means with a control element for displacing the at least one actuator from its release position into its actuation position upon displacement of the ignition means after actuation of the setting tool, from an ignition-ready position of the ignition means into its ignition position.

Advantageously, the transporting device displacing means includes two locking members axially offset relative to each other and arranged on opposite sides of the guide channel. With two locking members, the transportation path of the transporting device can be divided in two parts or sections.

For effecting a complete transporting sequence for displacing a new propellant in a position coaxial with the propellant receptacle and, optionally for a complete transporting sequence for displacing a burnt-up propellant out of

a position coaxial with the propellant receptacle, actuation of both locking members one after another is necessary.

Advantageously, the locking members are formed as pawls pivotally supported on respective pivot supports. This permits to reduce the actuation force and the actuation path of the actuators.

It is further advantageous when the pivot supports are secured to the guide housing for the ignition means. This permits to obtain a compact structure.

The novel features of the present invention, which are considered as characteristic for the invention, are set forth in the appended claims. The invention itself, however, both as to its construction and its mode of operation, together with additional advantages and objects thereof, will be best understood from the following detailed description of preferred embodiment when read with reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

The drawings show:

FIG. **1** a partially cross-sectional view of a section of a combustion power-operated setting tool according to the present invention in an initial position of the setting tool;

FIG. **2** a cross-sectional view of the setting tool along line II—II in FIG. **1**;

FIG. **3** a cross-sectional view of the setting tool along line III—III in FIG. **1**;

FIG. **4** a cross-sectional view of the setting tool according to FIG. **3** in a partially pressed-on condition;

FIG. **5** a longitudinal cross-sectional view of a section of the setting tool showing a detailed view of the ignition unit;

FIG. **6** a cross-sectional view of the setting tool according to FIG. **2** in a completely pressed-on condition;

FIG. **7** a cross-sectional view of the setting tool according to FIG. **3** in a completely pressed-on condition;

FIG. **8** a cross-sectional view of the setting tool according to FIG. **3** in a release condition;

FIG. **9** a cross-sectional view of the setting tool according to FIG. **2** in its partially lifted-off condition; and;

FIG. **10** a cross-sectional view of the setting tool according to FIG. **3** in its partially lifted-off condition.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

A combustion power-operated setting tool **10** according to the present invention, which is shown in FIGS. **1** through **10**, includes a one-or multi-part housing **11**, and a piston guide **13** which is displaceably arranged in a receiving chamber **24** of the housing **11** and is supported in the housing **11** by a spring **17** that biases the piston guide **13** in a setting direction. A setting piston **15** is axially displaceably arranged in a guide chamber **14** of the piston guide **15**. In the piston guide **13**, there is provided a propellant receptacle **18** which is formed as a cartridge socket for receiving propellants **71**, e.g., cartridges with which the setting piston **15** is driven. An ignition unit **20** serves for ignition of a propellant **71** that is received in the propellant **71** that is received in the propellant receptacle **18** (see, in particular, FIG. **1**). As particular shown in FIG. **5**, the ignition unit **20** includes ignition means **23** which is displaceable in a firing pin guide **21** and which is formed as a firing pin. The ignition means **23** is biased in the ignition direction by a spring **25**.

On the housing **11**, there is provided, in the embodiment shown in the drawings, a handle **12** that carries an actuation switch **19** for actuating the ignition unit **20** and thereby the setting process. The actuation switch **19** is actuated by a user of the setting tool **10**.

Cartridges with propellants **71** are stored in a propellant magazine which is formed as a propellant strip **70** displaceable in a guide channel **22** by a transporting device **30**. The transporting device **30** has a transporting spring element **39** which is formed as a scroll spring having its free end secured at a point **29** to the housing **11** in the region adjacent to the ignition unit **20** and the receiving chamber **24**. Upon displacement the propellant strip **70** in the guide channel **22** in a direction opposite the transporting direction **63**, the transporting spring element **39** becomes tensioned and biases the propellant strip **70** in the transporting direction **63**. The transporting device **30** further includes two opposite, offset relative to each other locking members **31**, **32** arranged on opposite sides of the guide channel **22** and formed as pawls. The locking members **31**, **32** are pivotally arranged on respective pivot support **35**, **36** provided in a guide housing **28** of the ignition unit **20**. Two springs **33**, **34** bias the respective locking members **31**, **32** toward the guide channel **22**, as particularly shown in FIGS. **2**, **6**, and **9**. In the initial position of the setting tool **10**, which is shown in FIGS. **1–3**, the locking member **31** engages in a side recess **73** of the propellant strip **70**, whereas the second locking member **32** engages an elevation between two recesses **72** provided on opposite side of the propellant strip **70**. Both locking members **31**, **32**, thus, project into the guide channel **22** (see, in particular, FIGS. **2–3**). Both locking members **31**, **32** have each an actuation section **37**, **38** formed as inclination surface means. The actuation sections **37**, **38** cooperate with respective adjusting sections **47**, **48** of respective actuators **41** and **42**.

The first actuator **41**, which is formed as a pin, is arranged on the same side of the setting tool as the locking member **31** and is secured on the piston guide **13**. The adjusting section **47**, which is formed as an inclination surface, is provided at a free end of the actuator **41** and is spaced, in the initial position of the setting tool **10** shown in FIGS. **1–3**, from the actuation section **37** of the respective locking member **31**. The actuator **41** is displaceably arranged in a guide **45** provided in the guide housing **28** of the ignition unit **20**. The actuator **41** is displaceable against a biasing force of a spring **43**.

The second actuator **42**, which is also formed as a pin, is arranged on the same side of the setting tool **10** as the locking member **32**. The actuator **42** is displaceably arranged in a guide **46** provided in the guide housing **28** of the ignition unit **20**, and is displaceable against a biasing force of a spring **44**. The adjusting section **48** of the actuator **42** is formed as a blade-shaped projection. In the initial position shown in FIGS. **2–3**, the actuator **42**, together with its adjusting section **48**, is located in its release position **50** in which the adjusting section **48** is pivoted out from the axial projection of the actuation section **38** of the locking member **32**. An actuation of the locking member **32**, with the adjusting section **48** of the actuator **42** acting on the actuation section **38**, is not possible in the position **50** of the actuator **42**.

On the ignition means **23**, there is provided a control element **26** having a control section **27**. Upon displacement of the ignition means **23** toward the propellant receptacle **18** in the setting direction **60**, the control section **27** displaces the actuator **42**, together with its adjusting section **48**, in a manner of a link control, from its release position **50** in its actuation position **51** in which the adjusting section **48** is

pivoted into the axial projection of the actuation section **38** of the locking member **32**, as will be explained in more detail further below.

FIG. **4** show the setting tool **10** in a condition in which it is partially pressed with its mouth portion against a constructional component (not shown). In this position of the setting tool **10**, the piston guide **13**, together with the actuator **41**, is displaced in a direction **61** opposite the setting direction toward the ignition unit **20**. The adjusting section **47** of the actuator **41** acts on, applies pressure to the actuation section **37** of the locking member **31**, lifting it, against the biasing force of the spring **33** (not shown in FIG. **4**, see FIG. **2**), off its locking position in the recess **73** of the propellant strip **70**.

As a result, the propellant strip **70** is displaced in the transporting direction **63** by the transporting spring **39** (see FIG. **1**) until the locking member **32** engages, under the biasing force of the spring **34**, in the next recess **72** of the propellant strip **70** (see FIG. **4**). Now, the propellant strip **70** is located in a position in which a new propellant **71** is arranged coaxially with the propellant receptacle **18**.

With the setting tool **10** being further pressed against the constructional component, an actuator (not shown), which is provided on the piston guide **13** preloads the ignition means **23**, displacing it into its ignition position, as shown in FIG. **5**.

FIGS. **6–7** show the setting tool **10** in a position in which it is completely pressed against the constructional component. As a result of further displacement of the piston guide **13** in the direction **61**, the propellant **71** is pushed into the propellant receptacle **18**, becoming enclosed herein, as particularly shown in FIG. **7**. The locking member **31** still remains in its lifted off position in which it is held by the actuator **41**. The second locking member **32** meanwhile engages in the recess **72**. The actuator **42**, together with its adjusting section **48**, remains in its release position **50**, and the transporting device **30** remains, thus, in a position in which transportation of propellants is prevented.

FIG. **8** shows the setting tool **10** in a position in which the ignition has taken place, as shown by a burnt-up propellant **71***b*. To this end, upon actuation of the actuation switch **19** (see FIG. **1**), the ignition means **23** strikes the propellant **71**, igniting the same, upon being displaced by the biasing force of the spring **25** (see FIG. **5**). With this, the control section **27** of the control element **26** engages the adjusting section **48** of the actuator **42**, displacing the actuator **42** in its actuation position **51**, shown in FIGS. **8–10**, and in which the adjusting section **48** lies in the axial projection of the actuation section **38** of the locking member **32**. The position of the first locking member **31** remains unchanged.

FIGS. **9–10** show the setting tool **10** in a condition in which it is almost completely lifted off the constructional component. In this position of the setting tool **10**, the piston guide **13** and the actuator **41**, **42** are displaced in the setting direction **60** away from the ignition unit **20**. As a result, the actuator **41** releases the locking member **31**, which is pivoted by the spring **34** in the guide channel **22** in the direction toward the propellant strip **70** and which engages an elevation between two recesses **73** in the propellant strip **70**. Immediately thereafter, the adjusting section **48** of the actuator **42** acts on the actuation section **38** of the locking member **32**, pivoting the locking member **32** out of the recess **72**. In this position of the transporting device **30**, the propellant strip **70** is transported by the transporting spring **39** (see FIG. **1**) further forward until the locking member **31** engages in the next recess **73**. The propellant strip **70** occupies an intermediate position, shown in FIGS. **9–10**, in which enclosure of the next, non-burnt-up propellant **71** in the propellant receptacle **18** is not possible as the propellant **71** is not coaxially aligned with the propellant receptacle **18**.

Upon a complete lifting of the setting tool **10** of the constructional component, the actuator **42** is displaced, with link control means, not shown, from its actuation position **51** in its release position **50** in FIG. **2**, and the setting tool **10** is returned into its initial position. Actuation of the locking member **32** is not possible without a new actuation of the ignition means **23**.

In the inventive setting tool **10**, transportation of the propellants is reliably prevented even when the actuation switch **19** is actuated but the ignition means **23** or the fire pin does not strike the propellant **71**. The actuator **42** is not displaced, at that, in its actuation position, and the locking member **32** is not lifted off the respective recess **72**, even upon the setting tool being again lifted off the constructional component.

Further, the inventive setting tool can be provided with a simple detection device that would prevent a press-on process when the presence of a fastening element in the bolt guide of in the magazine of fastening elements is not detected. In this case, the actuator **41** would not lift the locking member **31** off the recess **73** in the propellant strip **70**, and the propellant strip cannot be displaced further.

The setting tool according to the present invention can further be provided with means for manual lifting of the locking members **31**, **32** off the guide channel, so that the propellant strip **70**, which is located in the guide channel **22**, can be removed from the tool even when the strip is not completely spent.

Though the present invention was shown and described with reference to the preferred embodiment, such is merely illustrative of the present invention and is not to be construed as a limitation thereof and various modification of the present invention will be apparent to those skilled in the art. It is therefore not intended that the present invention be limited to the disclosed embodiment or details thereof, and the present invention includes all variations and/or alternative embodiments within the spirit and scope of the present invention as defined by the appended claims.

What is claimed is:

1. An explosive powder charge-operated setting tool for driving fastening elements in a constructional component, comprising a propellant-driven setting mechanism including a propellant receptacle (**18**) for receiving a propellant (**71**); ignition means (**23**) for igniting the propellant (**71**) received in the propellant receptacle (**18**); a guide channel (**22**) for receiving a propellant magazine; and a transporting device (**30**) for displacing the propellant magazine in the guide channel (**22**) and including means operable by the ignition means (**23**) for displacing the transporting device from a first position in which the transportation of propellants is prevented, into a second position in which at least partial transportation of the propellants is possible.

2. A setting tool according to claim **1**, wherein the transporting device (**30**) includes transporting spring means (**39**) for biasing the propellant magazine, which is received in the guide channel (**22**) in a transporting direction (**63**).

3. A setting tool according to claim **1**, wherein the transporting device displacing means comprises at least one locking member (**31**, **32**); and a spring (**33**, **34**) for biasing the at least one locking member (**31**, **32**) in a direction toward the guide channel into a position in which transportation of the propellant is blocked.

4. A setting tool according to claim **3**, wherein the transporting device (**30**) includes at least one actuator (**41**,

42) for displacing the at least one locking member (31, 32) against a spring-biasing force of the biasing spring (33, 34) from the position in which the transportation of the propellants is blocked, into a position in which the transportation of the propellants becomes possible.

5. A setting tool according to claim 4, wherein the at least one actuator (42) is displaced by the ignition means (23) from a release position (50) in which displacement of the at least one locking member (32) by the actuator (42) is prevented, into an actuation position (51) in which the displacement of the at least one locking member (32) by the actuator (42) becomes possible.

6. A setting tool according to claim 5, wherein the ignition means (23) comprises a control element (26) for displacing the at least one actuator (42) from the release position (50) thereof into the actuation position (51) thereof upon displacement of the ignition means (23), after actuation of the setting tool (10), from an ignition-ready position of the ignition means (23) into an ignition position thereof.

7. A setting tool according to claim 3, wherein the transporting device displacing means comprises two locking members (31, 32) axially offset relative to each other and arranged on opposite sides of the guide channel (22).

8. A setting tool according to claim 7, comprising means for actuating both locking members (31, 31) one after another for effecting a complete transporting sequence for displacing a new propellant in a position coaxial with the propellant receptacle (18).

9. A setting tool according to claim 8, wherein actuation of both locking members one after another takes place for effecting a complete transporting sequence for displacing a burnt-up propellant out of a position coaxial with the propellant receptacle (18).

10. A setting tool according to claim 7, wherein the two locking members (31, 32) are formed as pawls pivotally supported on respective pivot supports (35, 36).

11. A setting tool according to claim 10, wherein the pivot supports (35, 36) are secured on a guide housing (28) for the ignition means (23).

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